5.0 Findings

In the 1950s and 1960s, the workers and management at the PGDP, then the area's largest employer, were performing highly important, technologically challenging, and secret work contributing to the national defense. In the midst of the Cold War, the number one priority at PGDP was the production of enriched uranium. Federal and Commonwealth of Kentucky standards for safety and health were just beginning to evolve. Environmental protection standards were limited, and restrictions on waste disposal and environmental discharges were rudimentary. ES&H practices have evolved and improved over the years of Plant operation as knowledge was gained about hazards and controls and as new Federal regulations required improvements, especially in the 1970s, in activities affecting the environment.

Health and safety programs were established before startup at PGDP and included policies, procedures, training, monitoring, and equipment for protecting personnel from hazards at the Plant. Industrial safety was emphasized, with safety committees, publications and posters, frequent safety meetings, and JHAs developed early on for most work activities. The Health Physics and Hygiene Department performed studies of hazards and health effects and surveys and evaluations of working conditions. They also provided line management with recommendations for engineering and administrative controls for hazards. PPE, such as coveralls, gloves, safety glasses, hearing protection, shoes, and respirators, were provided or made available to workers deemed to need them. A variety of personnel monitoring methods, including film badges, urinalysis, and lung counting, were used to determine their exposure to radiological and some chemical hazards and to monitor responses to significant intakes and exposures.

Although the intention to protect workers from the radiological (including transuranic) hazards was apparent, the implementation of the radiological protection program at PGDP was very inconsistent between 1952 and 1989. Limited health physics staffing, a failure to communicate exposure levels and transuranic hazards to workers, worker failure to follow radiological control measures, a failure to consistently enforce radiological control measures, and a lack of adequate understanding and appreciation of the hazards of uranium and transuranics all contributed to inconsistent implementation. The lack of understanding was illustrated by crude experiments at PDGP designed to measure excretion rates, including voluntary inhalation and ingestion of uranium compounds to cause intakes. Line management was responsible for ensuring personnel protection and compliance, and the Health Physics and Hygiene Department staff were advisors only, having no enforcement role. Rigid "need to know" AEC security requirements, a predominantly military veteran workforce, and job insecurity all contributed to an unquestioning attitude, a lack of understanding of hazards, and the resulting inconsistent compliance with controls. An additional impediment was the physical discomfort of wearing ill-fitting PPE, including early styles of masks and respirators, in the often hot and dirty work environments in many areas of the Plant.

There was a widespread belief that uranium did not present a significant health risk to workers. Consequently, eating, drinking, and smoking in contaminated areas; failure to wash or remove contaminated clothing before entering the cafeteria; and wearing contaminated clothing off site without monitoring all occurred during this period. The Health Physics and Hygiene Department assumed that nearly all uranium ingested or inhaled was soluble and quickly excreted from the body without harm or long-term effects. In fact, aerosols of insoluble uranium compounds were generated in some work areas, such as in the feed plant, and by maintenance activities, such as grinding, buffing, and welding. Many hazard controls were recommended or implemented after significant exposures or as a result of high bioassay or air sample readings rather than in a pre-planned, proactive manner. Although ALARA and its predecessor concepts were stated policy, they were not actual practice.

The presence of transuranics including plutonium and neptunium, with a higher specific activity and exposure potential than uranium, constituted a significant inhalation hazard for workers. This was especially true for workers engaged in activities where the transuranics were more concentrated or where there was airborne exposure, such as feed production, ash handling, neptunium recovery, metals production, reactor tails feeding or product withdrawals, and cascade improvement and modification activities. The need for extremity (hand or foot) monitoring for workers performing activities in or near high radiation fields was not recognized, and overexposures may have gone undetected. The presence of transuranics and the reasons for additional controls were not shared with workers. Exposure history was also not provided to workers unless requested. These practices contributed to inconsistent compliance with PPE recommendations.

Airborne releases of radiological and chemical materials were frequent in the 1950s, significantly decreasing in frequency and quantity after the mid-1960s. In some cases, these releases were not adequately monitored, documented, mitigated, or reported. Until the mid-1970s, uranium and fluorine were released unmonitored from process, feed and metals production, and cleaning (decontamination) building stacks. Intentional and improper cell venting to the atmosphere on the backshifts ("midnight negatives") reportedly occurred. "Puffs" of UF_6, HF, and fluorine resulted in hazards to workers, and accidents resulted in the release of visible clouds of UF_6 gas on and off site, often without adequate monitoring or documentation. Acute and chronic exposures to chemical hazards such as TCE, PCBs, and HF occurred, and the potential risks of such exposures were not fully recognized by workers or the Health Physics and Hygiene Department. Exposures to HF resulting in burns, respiratory distress, and bleeding were frequent in the 1950s and 1960s, and their potential long-term health effects are unknown. The determination of the long-term consequences of potentially unmonitored or chronic exposures to radiation and other hazards was outside the scope and resources of this investigation.

Early waste disposal practices at Paducah were consistent with general industry practices at the time and included burial, dilution, and incineration. By today's standards, there were numerous examples of inadequate control and monitoring of liquid effluents, including radiological and chemical waste streams. Uranium solutions were channeled into the sewage treatment system and later contained in the sewage sludge used for fertilizer on site; contaminated laundry solutions were discharged or dumped into lagoons and into the North-South Diversion Ditch; and acids and chromates were discharged into the Bayou Creeks at such levels that DOE had to purchase the property adjoining Little Bayou Creek. PCBs and TCE were discharged to the ground, and liquid radiological and chemical wastes from process operations were discharged to unlined lagoons, ditches, and creeks. Ongoing monitoring and remediation programs are addressing the impacts of legacy contamination from these historical discharge practices and events.

Unsegregated radiological and chemical materials and waste were dumped or buried both inside and outside the fence on DOE property and were not controlled or documented. For example, contaminated concrete rubble and contaminated roofing materials were dumped outside the fence; contaminated sewage sludge was placed in landfills or on site lawns as fertilizer; and contaminated drums, equipment, and materials were dumped in lagoons, burial holes, or piles. Identification, characterization, and remediation of these legacy waste issues are ongoing programs at the Plant.

To put PGDP conditions and activities into perspective, it must be considered that almost 50 years ago there was a significantly smaller body of knowledge about radiation, chemical, and other industrial hazards and their effects on humans and the environment. Global political conditions were different, and attitudes towards openness, worker protection, and environmental stewardship were less sophisticated. Industries, including the AEC/ERDA/DOE complex, were largely self-regulated; guidance and standards were evolving. Although some PGDP exposures may not have been identified and recorded, and those that were measured are high by today's standards, only two reported exposures were above the governing regulatory limits. Total PGDP exposures were generally comparable to similar activities across AEC/ERDA/DOE, Defense Department facilities, and commercial nuclear plants at that time.